AIEWS/Combat Direction System Functional Allocation

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CONTENTS

ILLUSTRATIONS

1. Scope

1.1. Identification

This document describes the functions allocated between the Combat Direction System (CDS) and the Advanced Integrated Electronic Warfare System (AIEWS) and defines terms that describe these functions and associated data flows. This white paper establishes common terminology and concepts between the two systems.

1.2. System Overview

1.2.1. Combat Direction System Overview

AEGIS Combat System Overview

The AEGIS Combat System (ACS) is an automated, highly integrated, multi-mission, high availability warfighting system. The ACS provides Air Warfare (AW), Surface Warfare (SUW), Under Sea Warfare (USW), Command and Control Warfare (C^2W), Strike Warfare (STW) and Theater Ballistic Missile Defense (TBMD) mission capability to the Ticonderoga (CG 47) and Arleigh Burke (DDG 51) ship classes. The AEGIS Weapon System (AWS) is the integrating element of ACS and will service the interface with AIEWS. AWS serves as the automated focal point within the ACS for the collection, analysis, correlation, association and coherent presentation of own-ship and off-board multiple-sensor data and is the central track data source for ship-ship tactical link communications. AWS computes identification and threat engageability; initiates engagements; carries out kill assessment; and, provides command information and display services to enhance tactical awareness and support tactical operations.

Integrated Ship Defense System (ISDS) Overview

The ISDS is the integration of the Quick Reaction Combat Capability (QRCC), the Advanced Combat Direction System (ACDS), and the Cooperative Engagement Capability (CEC). This integration provides a unified system for Navy surface combatant defense. QRCC provides the ship defense subsystems and automated engagement responses necessary to defeat air threats to own-ship. ACDS provides real-time command support for coordinated Air Warfare (AW), Surface Warfare (SUW), UnderSea Warfare (USW), Command and Control Warfare (C^2W), and Strike Warfare, enabling force-level coordinated multi-warfare ship defense by integrating a spectrum of information and track data from both organic and off-board sources. CEC forms a timely, accurate, distributed AW picture and shares fire control quality data among individual ships in a highly reliable network, which establishes a coherent real-time, composite track database that can be used to conduct weapon engagements.

1.2.2. AIEWS Overview

The AIEWS is an element of the Combat System that provides Electronic Warfare Attack (EA) and Electronic Warfare Support (ES) functions. It is the primary EW system supporting Command and Control Warfare (C^2W). AIEWS provides full EW support across the offensive and defensive envelope to include:

Situation Awareness. AIEWS detects, tracks, and classifies enemy, neutral, and friendly emitters. AIEWS provides a number of classification methods when the tactical situation allows. Classification methods include Specific Emitter Identification (SEI), functional identification, and classical parameter lookup. Also, AIEWS provides sufficient angular accuracy to allow timely correlation with active radar tracks.

Engagement Support. AIEWS supports Combat Direction System management of engagements by supporting coordination of EA with hardkill assets under Combat System doctrine control, providing early threat warning, supporting sensor cues, and reporting ES data for kill assessment.

Counter-Antiship Missile. For active RF, IR, and active RF/IR dual-mode seeker, AIEWS inhibits initial missile seekers lock-on or produces trajectory alteration away from the ship.

Counter-Targeting. AIEWS inhibits and delays enemy radars from locating and targeting own-ship or other protected battle force ships.

2.   Allocated Combat System Functions

AIEWS is one element of the Combat System (CS). The following paragraphs address the functions allocated to the AIEWS element and the functions allocated to other Combat System elements (for simplicity, in this document non-AIEWS elements are hereafter referred to as "Combat Direction System"). The functions allocated in this document are not all of the AIEWS or Combat Direction System functions – just the functions needing clarification.

Combat System functions have been grouped into the following primary areas: detect, control, and engage. The rest of this section describes the three primary functions, decomposes the primary functions into subfunctions, describes the subfunctions, and lists information passed between the AIEWS and Combat Direction System subfunctions. The allocation of the Combat Direction System subfunctions is shown in Figure 2-1.
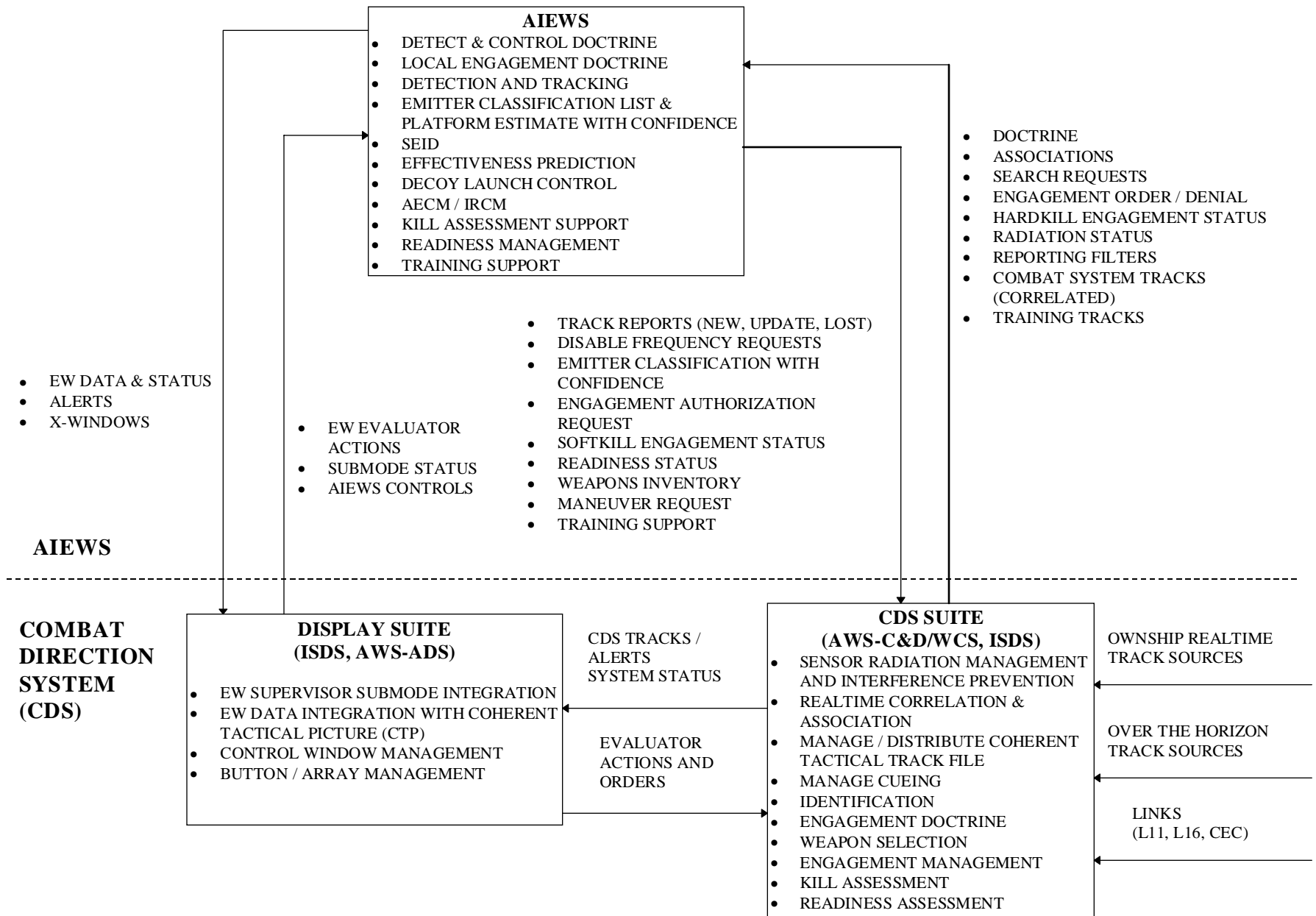
AIEWS
- DETECT & CONTROL DOCTRINE
- LOCAL ENGAGEMENT DOCTRINE
- DETECTION AND TRACKING
- EMITTER CLASSIFICATION LIST & PLATFORM ESTIMATE WITH CONFIDENCE
- SEID
- EFFECTIVENESS PREDICTION
- DECOY LAUNCH CONTROL
- AECM / IRCM
- KILL ASSESSMENT SUPPORT
- READINESS MANAGEMENT
- TRAINING SUPPORT

- DOCTRINE
- ASSOCIATIONS
- SEARCH REQUESTS
- ENGAGEMENT ORDER / DENIAL
- HARDKILL ENGAGEMENT STATUS
- RADIATION STATUS
- REPORTING FILTERS
- COMBAT SYSTEM TRACKS (CORRELATED)
- TRAINING TRACKS

- TRACK REPORTS (NEW, UPDATE, LOST)
- DISABLE FREQUENCY REQUESTS
- EMITTER CLASSIFICATION WITH CONFIDENCE
- ENGAGEMENT AUTHORIZATION REQUEST
- SOFTKILL ENGAGEMENT STATUS
- READINESS STATUS
- WEAPONS INVENTORY
- MANEUVER REQUEST
- TRAINING SUPPORT

- EW DATA & STATUS
- ALERTS
- X-WINDOWS

- EW EVALUATOR ACTIONS
- SUBMODE STATUS
- AIEWS CONTROLS

AIEWS

COMBAT DIRECTION SYSTEM (CDS)

DISPLAY SUITE (ISDS, AWS-ADS)
- EW SUPERVISOR SUBMODE INTEGRATION
- EW DATA INTEGRATION WITH COHERENT TACTICAL PICTURE (CTP)
- CONTROL WINDOW MANAGEMENT
- BUTTON / ARRAY MANAGEMENT

CDS TRACKS / ALERTS SYSTEM STATUS

EVALUATOR ACTIONS AND ORDERS

CDS SUITE (AWS-C&D/WCS, ISDS)
- SENSOR RADIATION MANAGEMENT AND INTERFERENCE PREVENTION
- REALTIME CORRELATION & ASSOCIATION
- MANAGE / DISTRIBUTE COHERENT TACTICAL TRACK FILE
- MANAGE CUEING
- IDENTIFICATION
- ENGAGEMENT DOCTRINE
- WEAPON SELECTION
- ENGAGEMENT MANAGEMENT
- KILL ASSESSMENT
- READINESS ASSESSMENT

OWNSHIP REALTIME TRACK SOURCES

OVER THE HORIZON TRACK SOURCES

LINKS (L11, L16, CEC)

Figure 2-1 Combat System Functions

2.1.   Detect Function

The detect functions for the AIEWS and the other Combat System elements are discussed in the following paragraphs and shown in Figure 2-2 Detect Functions.
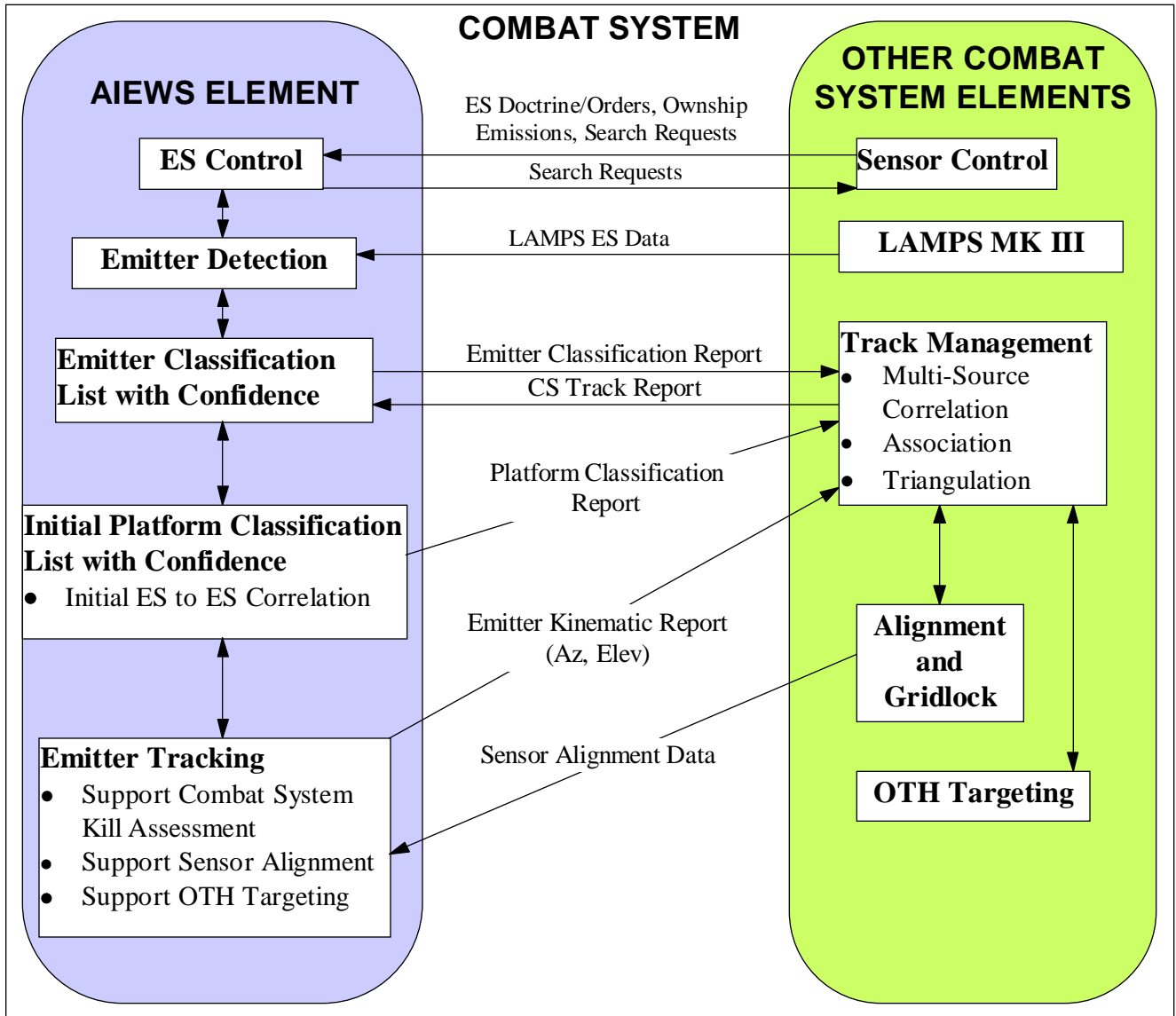
COMBAT SYSTEM

AIEWS ELEMENT

OTHER COMBAT SYSTEM ELEMENTS

ES Doctrine/Orders, Ownship Emissions, Search Requests

ES Control

Search Requests

Sensor Control

LAMPS ES Data

Emitter Detection

LAMPS MK III

Emitter Classification Report

Emitter Classification List with Confidence

CS Track Report

Track Management
- Multi-Source Correlation
- Association
- Triangulation

Platform Classification Report

Initial Platform Classification List with Confidence
- Initial ES to ES Correlation

Emitter Kinematic Report (Az, Elev)

Alignment and Gridlock

Sensor Alignment Data

OTH Targeting

Emitter Tracking
- Support Combat System Kill Assessment
- Support Sensor Alignment
- Support OTH Targeting

Figure 2-2 Detect Functions

2.1.1.   Sensor Control

The Combat Direction System is responsible for controlling the sensor suite as a whole. AIEWS is responsible for controlling its ES within the constraints provided from the Combat Direction System as ES doctrine and orders. The ES doctrine and orders may affect ES sensitivity, filters, blanking inputs, sensor search requests, etc.

Own-ship emission information. AIEWS shall be designed to accept inputs directly from own-ship emitters as well as blanking systems. AIEWS will require own-ship emitters to provide the following information to support the blanking process: start of pulse, pulse width and frequency data.

Search Request to AIEWS. The Combat Direction System has the capability to make a search request that would tailor AIEWS ES sensitivity controls to increase the probability of detecting an emitter which is suspected to be operating. AIEWS would optimize available resources to determine and send the results of the search to the Combat Direction System.

Search Request to other Combat System elements. AIEWS has the capability to request the Combat Direction System for a cued target search along a specified bearing or region in response to a special, high value, or uncorrelated ES contact. The Combat Direction System will assess the request and determine if other Combat System sensor resources are available to perform the search. If the Combat Direction System responds to the AIEWS request, the Combat Direction System will send the results of the search to AIEWS.

2.1.2. Emitter Detection

The AIEWS is responsible for detecting emitters. AIEWS will detect and measure incoming pulses, derive parameters from pulse information, perform emitter contact formation by associating individual pulses, and maintain ES tracks that represent ES detected emitters. The following list is a sample of the information that the AIEWS determines for an emitter: azimuth angle, azimuth rate, elevation angle, elevation rate, frequency, pulse width, time of arrival, amplitude, signal modulations, and emitter classification.

The AIEWS will utilize LAMPS ES data as input to support the AIEWS emitter detection and classification functions. The AIEWS will provide automated and manual controls to manage the LAMPS ES processing. The AIEWS will perform the following functions to support the LAMPS platform: provide tailored emitter information to the LAMPS, specify search controls to LAMPS, assist in the LAMPS emitter classification process, and provide LAMPS ES status to the Combat Direction System.

The AIEWS, when deployed with an IRCM subsystem, will have an additional capability to detect a threat through the IRCM subsystem. The IRCM subsystem must be cued from either an AIEWS ES track or by another sensor. The cue to the IRCM may originate from the Combat Direction System or the AIEWS. Once cued, the IRCM subsystem can locate, determine the range, and classify an IR threat.

2.1.3. Emitter Classification

The AIEWS is responsible for emitter classification and corresponding confidence estimate. Based on the attribute measurements of a detected emitter, AIEWS determines an emitter classification with a confidence estimate. If the AIEWS can not uniquely determine the emitter classification, a classification list with corresponding confidence estimates will be provided to the Combat Direction System. The emitter classification report will include measured emitter attribute data and the resulting emitter classification, including, if available, emitter function, SEI

classification, SEI parameters, emitter status, and emitter mode. AIEWS will send emitter classification reports on a periodic basis, upon the detection of a change in the emitter (i.e. emitter mode, emitter attributes) or upon request from the Combat Direction System. The AIEWS will continuously classify ES tracks based on its current and previously stored data.

The Combat Direction System provides AIEWS with Combat System tracks that have been correlated to AIEWS ES tracks. AIEWS can use the correlated track information to refine ES processing and support EA functions.

2.1.4. Track Management

The Combat Direction System is responsible for overall track management, combat system track formation, final correlation (including ES to ES), final association, and triangulation. AIEWS will support Combat Direction System track management via emitter classification and kinematic reports, composite track to ES track correlation, and ES track reports that include associated ES sensor measurements. Combat Direction System track management functions include:

1. Combat system track formation employs calculation, analytical optimization, and correlation techniques across dissimilar track data from own-ship radar, ES, EO/IR, and off-board sources. A combat system track may be formed based on data from one or more sensors.
2. The Combat Direction System determines which tracks should be correlated and provides the results to AIEWS.
3. The Combat Direction System determines what information is valid and should or should not be associated with a Combat System track.
4. The Combat Direction System triangulates two or more (own-ship or remote) tracks that are presumed to be the same emitter/object into a single track.

2.1.5. Emitter Tracking

AIEWS is responsible for tracking detected emitters and reporting the kinematics of these tracks to the Combat Direction System. The kinematic report will include azimuth angle (and rate of change) and elevation angle (and rate of change). AIEWS will send all ES track reports at the periodic rate requested by the Combat Direction System or default to a rate dependent upon the ES track category, estimated platform type, or doctrine.

2.1.6. Initial Platform Classification

The AIEWS is responsible for providing the initial platform classification and associated confidence estimate. AIEWS will report any ambiguities as a platform classification list with associated confidence estimates. AIEWS is responsible for updating the initial platform classification as changes occur to ES track parameters. The Combat Direction System is responsible for the final platform classification.

Initial ES to ES Correlation. AIEWS is responsible for an initial emitter to emitter (ES to ES) correlation of platforms. The Combat Direction System is responsible for making the final correlations (including ES to ES). The Combat Direction System will provide AIEWS the final correlation decisions.

2.1.7. Sensor Alignment and Gridlock

The Combat Direction System is responsible for determining sensor misalignment and passing sensor alignment data to AIEWS. Using the sensor alignment data, AIEWS will correct its measured kinematic data before sending it to the Combat Direction System. The Combat Direction System is responsible for gridlocking the data from the aligned sensors.

2.1.8. Over-The-Horizon Targeting

The Combat Direction System is responsible for OTH-Targeting. AIEWS emitter reports related to OTH targets may support this Combat Direction System function.

2.2. **Control Function**

The following sections describe the functions used to establish and maintain the control function. Figure 2-3 Control Functions illustrates the subfunctions of AIEWS and the Combat System control functions with data flows.
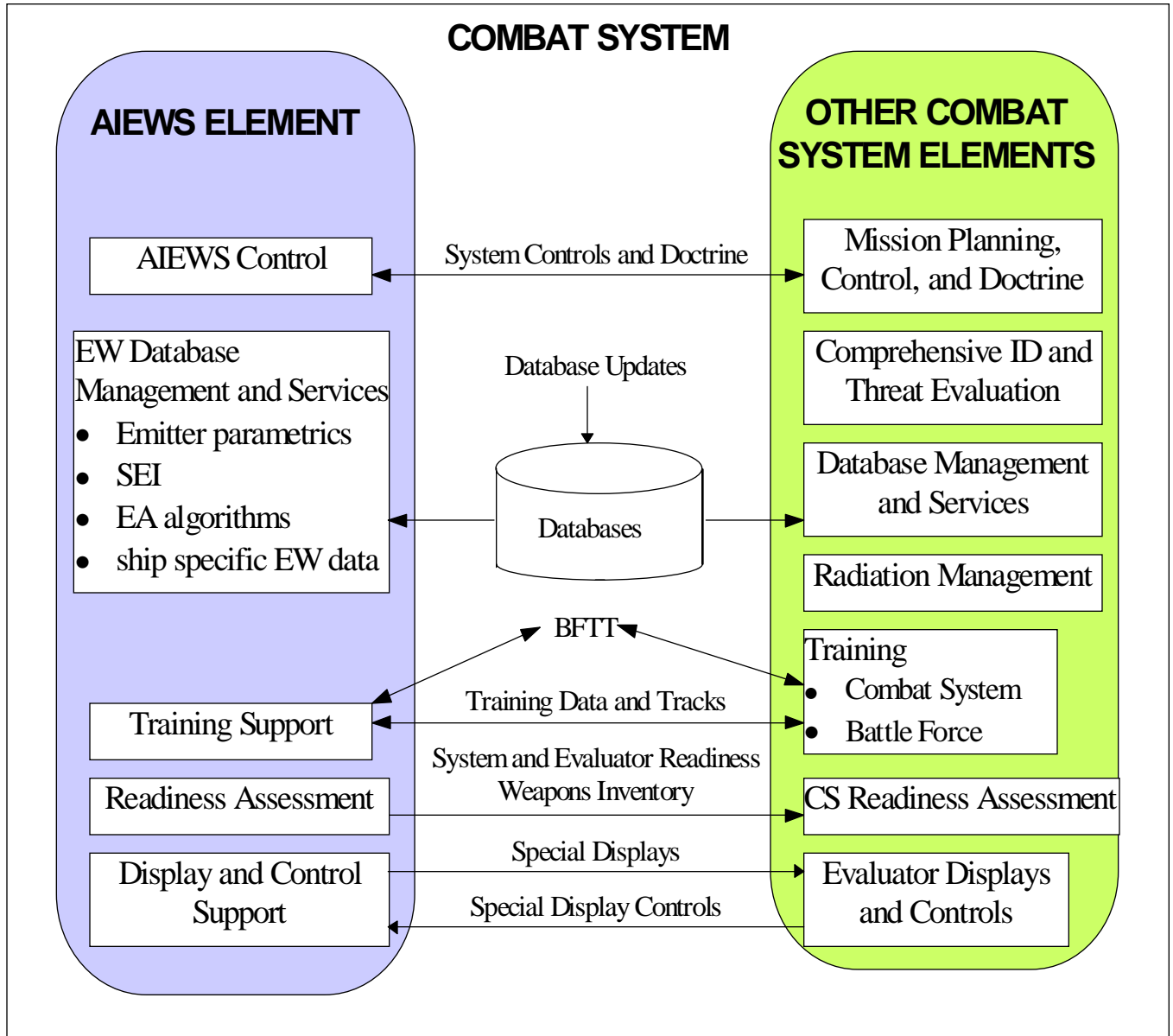
Figure 2-3 Control Functions

2.2.1. Mission Planning, Control, and Doctrine

The Combat Direction System is responsible for mission planning, control, and doctrine. As a result of the mission planning function, the Combat Direction System implements the warfighting constraints and preferences by sending controls and doctrine to the Combat System elements. For example, the Combat Direction System could establish an operating mode (e.g., tactical, training, test, maintenance) for all or some of the Combat System elements. The Combat System controls and doctrine can tailor AIEWS operation in areas such as the following:

a) Sensor management
b) Sensor search requests
c) Track initiation/termination
d) Reporting rates
e) Weapon management
f) Engagement initiation/termination

2.2.2. Comprehensive ID and Threat Evaluation

The Combat Direction System is responsible for the ultimate identification and threat evaluation of tracks/platforms based on all available information including inputs from the Combat System elements. AIEWS supports this Combat Direction System function by providing emitter classification (including initial platform classifications) and emitter kinematic reports to the Combat Direction System.

2.2.3. Database Management and Services

It is envisioned that there will be common databases accessible to all Combat System elements to prevent the usage of different database versions between the Combat System elements. Combat System elements can access and make copies of any databases needed. Whenever a change or update occurs to the common databases, each system would be informed of the change and required to resynchronize data in any local copy.

AIEWS will be responsible for database management and services of the following EW-specific databases: emitter attribute data (i.e., classical parameters to emitter name relationships), SEI data, EA algorithms, and ship specific EW data (e.g., decoy launcher installation locations).

The Combat Direction System will be responsible for database management and services of the following non-emitter databases: platform data (i.e., platform characteristics (to include installed emitters) to platform name relationships), doctrine statements, and ship specific data.

2.2.4. Radiation Management

The Combat Direction System is responsible for radiation management. Radiation management supports frequency coordination via EMCON plan integration, minimizes EMI effects, and supports safety requirements. AIEWS must adhere to the provided radiation management information. The Combat Direction System can define inhibit frequencies and inhibit regions to prohibit or control the use of AIEWS EA assets. During an active EA engagement, AIEWS will provide its intended use of active RF and frequency control information to the Combat Direction System for use in minimizing interference with other Combat System sensors.

2.2.5. Training

The Combat Direction System is responsible for training the Combat System elements as a team. AIEWS provides training for all EW evaluator tasks not included as part of the Combat System team training. AIEWS and Combat Direction System training communications will be clearly distinguished as training versus real data. AIEWS is responsible for providing AIEWS maintenance training. The Combat Direction System and AIEWS both support training with the Battle Force Tactical Trainer (BFTT).

2.2.6. Readiness Assessment

The Combat Direction System is responsible for a readiness assessment of the Combat System as a whole using its own and each element's readiness assessment. AIEWS will assess and report its ability to detect emitters, and engage threats to the Combat Direction System. AIEWS will also report weapon inventory (EW expendables) and evaluator readiness (based on training and operational assessments).

2.2.7. Displays and Controls

The Combat Direction System is responsible for providing the EW evaluator displays and control devices for the Combat System elements. AIEWS supports the Combat Direction System with EW information needed to support the Combat Direction System-generated tactical picture. AIEWS may provide special display data to the Combat Direction System displays for EW evaluator tasks not provided by the operational displays and controls, like maintenance. AIEWS will support evaluator actions and controls related to these AIEWS generated special displays.

2.3. Engage Function

The AIEWS and the other Combat System elements engage functions are discussed in the following paragraphs and shown in Figure 2-4.
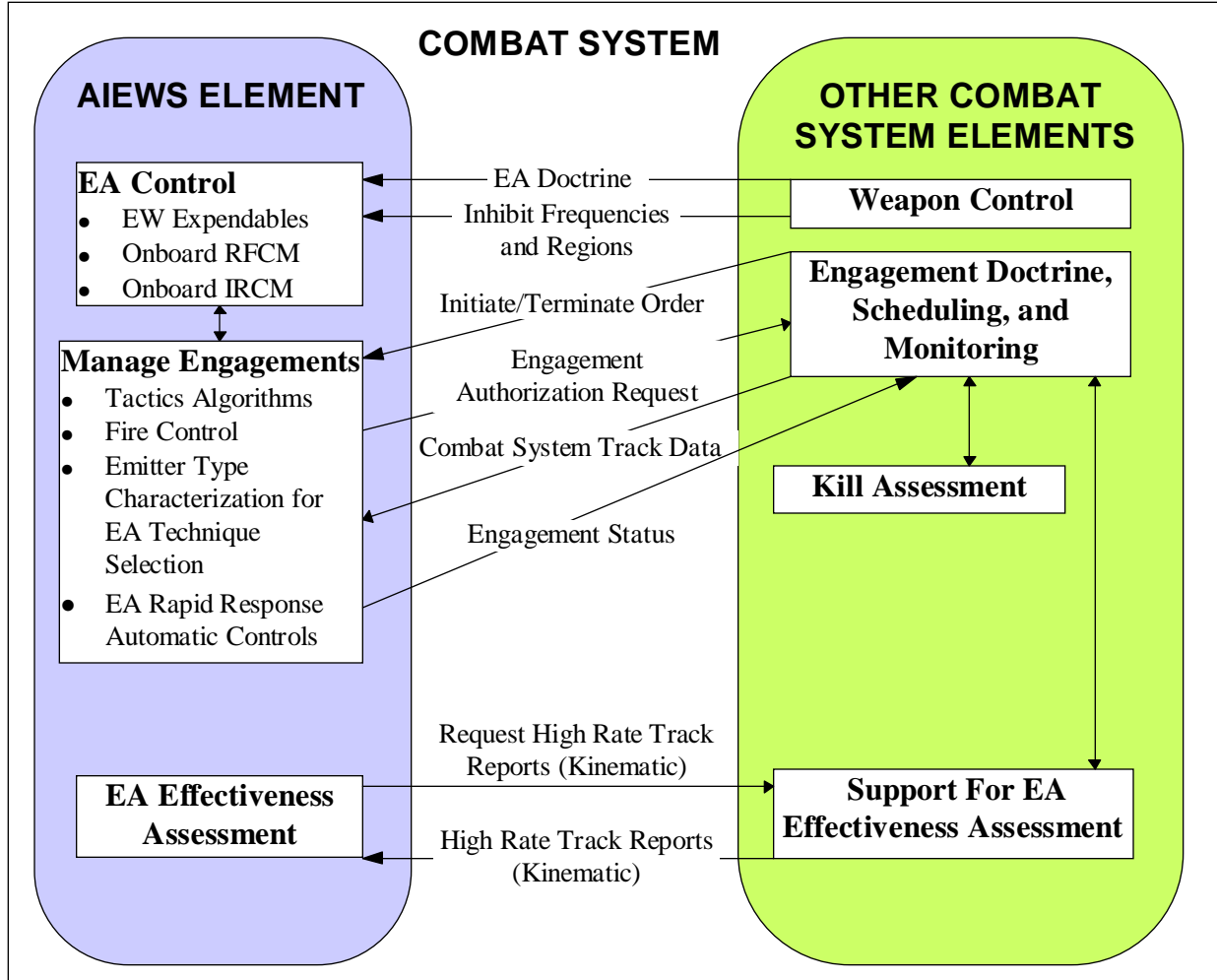
Figure 2-4 Engage Functions

2.3.1. Weapon Control

The Combat Direction System is responsible for overall Weapon Control and Engagement Management.

2.3.2. Engagement Doctrine, Scheduling, and Monitoring

AIEWS supports Combat Direction System engagement scheduling and monitoring, allowing for evaluating the current status of engagements, modifying predefined engagement inhibit regions, and identifying potential conflicts in light of current and proposed engagement activity. AIEWS will provide an engagement authorization request containing candidate EA engagement sequences together with ship maneuver requests if required and an EA effectiveness estimate.

AIEWS will use self generated ES information to support EA technique selection until superseded by Combat Direction System track information (i.e. emitter classification and platform classification, range, etc.). AIEWS EA control of onboard RFCM, onboard IRCM, and EW expendables allows for engagement sequences to counter RF, IR, and RF/IR dual mode targets.

2.3.3. Manage AIEWS Engagements

The Combat Direction System can order AIEWS to initiate or terminate an EA engagement. Combat System doctrine statements may also allow AIEWS to initiate an EA engagement in response to specified pre-conditions. AIEWS will report engagement status on all active and pending engagements including an estimate of EA effectiveness.

2.3.4. Kill Assessment

The Combat Direction System is responsible for kill assessment. Kill assessment is the means by which the Combat Direction System evaluates and determines that a specific engaged target has been destroyed. AIEWS supports the Combat Direction System's kill assessment by providing continuous ES reports and an EA effectiveness assessment for all AIEWS engaged targets. If requested, AIEWS will provide the Combat Direction System with high rate track reports on targets that the Combat Direction System is engaging. AIEWS observations and reports are continuous until either a loss of track has been determined or a cease report order is received from the Combat Direction System. High quality track data from the IRCM sensor can also be utilized to support kill assessment.

2.3.5. EA Effectiveness Assessment

The AIEWS is responsible for detecting changes in a target's emissions and assesses the changes to determine EA effectiveness. AIEWS may request high rate track reports from the Combat Direction System to support the EA effectiveness assessment. These kinematic reports may indicate an EA-altered trajectory which assists AIEWS in managing its EA assets.

3.   Glossary

Ambiguity	Uncertainty due to multiple targets having similar parameters within a single data set.
Battle Force Training	Distributed function performed by several ship and land platforms which monitors systems' evaluators and assesses their performance during controlled exercises.
Combat System Training	A Combat Direction System function which conducts controlled exercises and assesses evaluators' performance.
Combat System Doctrine	Is the means by which Decision Authority implements warfighting constraints and preferences, and is the embodiment of battle orders and rules of engagement translated into a set of rules which govern the behavior of the combat system and its associated elements.
Confidence	Degree of certainty or assurance associated with measured track data or calculated track attributes.
Derived Parameter	A calculated value using measured data, for example pulse repetition interval or scan period.
Electronic Attack (EA)	Use of electromagnetic (EM) energy, directed energy and/or decoys to attack personnel, facilities, or equipment with the intent of degrading, neutralizing, or destroying enemy combat capability.
Emitter Reports	AIEWS track data (AOA, frequency, AOA rates, etc.) sent to the Combat Direction System.
Electronic Warfare Support (ES)	Actions tasked by, or under direct control of, an operational commander to search for, intercept, identify, and locate sources of radiated EM energy for immediate threat recognition in support of EW operations and other tactical actions.
ES/EA Doctrine	Combat Direction System instructions describing the circumstances or limitations under which particular AIEWS actions or action sequences will be initiated or performed.
Functional Identification	Describes emitters in terms of their mission or task, e.g. emitter x is a targeting radar or emitter y is an acquisition radar, and typifies the associated platform.
Gridlock	A Combat Direction System function which supports the Ship Gridlock System, aligning local air and surface track position with reference to a common point.
OTH Targeting	A Combat Direction System function which targets surface threats (i.e. with Tomahawk/Harpoon) beyond the visual and radar horizons using AIEWS bearing.
Platform Identification	A Combat Direction System function which determines the platform by using AIEWS emitter reports, threat database contents, tactical data, and other sensor reports.
Ship Specific Data	Tailored ship configuration information, such as physical decoy launcher locations, own-ship radar cross section, antenna locations, etc.
Specific Emitter Identification (SEI)	An AIEWS function which uses detailed emitter characteristics to allow the association of the emitter with a particular platform.
System Track	Combat Direction System data characterizing an entity tracked by onboard and/or off-board sensors, created by one or more sensors.

4.   Acronyms and Abbreviations

AIEWS	Advanced Integrated Electronic Warfare System
AOA	Angle of Arrival (Azimuth and Elevation)
BFTT	Battle Force Tactical Trainer
C^2W	Command and Control Warfare
CDS	Combat Direction System
CS	Combat System
EA	Electronic Attack
EMCON	Emission Control
ES	Electronic Warfare Support
EW	Electronic Warfare
EMI	Electromagnetic Interference
ID	Identification or Identity
IR	Infrared
IRCM	Infrared Countermeasures
LAMPS	Light Airborne Multi-Purpose System
OTH	Over The Horizon
RF	Radio Frequency
SEI	Specific Emitter Identification